

From the Author

THE DISEASES AND PRIMARY TUMOURS OF THE THYMUS GLAND.

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BY

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London :

THE MEDICAL PUBLISHING COMPANY, LIMITED,
CLINICAL JOURNAL OFFICE : 22 $\frac{1}{2}$ BARTHOLOMEW CLOSE, E.C.



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THE thymus and the spleen form a distinct type of the ductless glands ; they are largely composed of lymphoid tissue, and, though they may be affected by disease originating elsewhere, are not, like the thyroid and supra-renal bodies, which may be considered as belonging to the type of the epithelial ductless glands, the primary cause of diseases like myxoedema, exophthalmic goitre, or Addison's disease.

There is, however, a difference between the thymus and the spleen in that the anatomical position of the thymus, in close contact with the trachea, heart, and great vessels, renders any increase in its size of importance from the mechanical pressure to which the neighbouring structures are subjected, while in the case of the spleen very great enlargement is readily compensated for in the capacious peritoneal cavity.

It may be interesting, therefore, to consider , systematically the various morbid conditions and

associations with disease to which the thymus gland is liable.

Preliminary.—The thymus is found in all vertebrate animals; entire absence of it in the newly born is extremely rare. It is a temporary lymphatic gland, reaching its maximum development at two years of age; it then remains in a more or less stationary condition until the eighth year or even later. It rapidly atrophies at the time of puberty, though it may, as will be seen later, persist for varying periods into adult life. In the process of involution the lymphoid tissue disappears and undergoes fatty infiltration, until eventually the place of the organ is taken by a mass of fat and connective tissue lying over and adherent to the pericardium. The process of fatty infiltration can often be seen microscopically, groups of fat-cells separating the lobules and cells of the organ.

The size and involution of the thymus are subject to very considerable variations, and are far from being regular or conforming to any rigid time limit.

It has been called the lymphatic gland of infancy, and might be thought to have some analogies with the hibernating gland of animals. Its duration of activity in the human subject also partly corresponds with the repose of intra-uterine and early independent life.

With regard to *the physiology* of the thymus there is little to say beyond classing it with lymphoid tissue generally; it is, like other lymphatic struc-

tures, apparently an important centre for leucocytosis, and to this its enlargement in certain chronic and possibly toxic conditions, such as cretinism, exophthalmic goitre, &c., might perhaps be assigned. As bearing on this it may be mentioned that the administration of thymus gland medicinally has sometimes appeared to have a good effect in ordinary goitre * and exophthalmic goitre.†

The extract of the gland has, like that of other tissues, been found to lead to intra-vascular clotting; it also lowers the blood-pressure. In connection with this last physiological effect it has been suggested that some cases of sudden death in children, where the thymus is found to be much enlarged, are due to the entry into the circulation of an excess of this substance, manufactured normally by the thymus.‡ This method of sudden death, if it occurs, is analogous to that sometimes seen after operations on the thyroid gland in exophthalmic goitre; in the latter case it is thought that owing to manipulation an excessive amount of thyroid secretion is forced into the circulation.

The physiological importance of the thymus gland in early life has been investigated by

* Mikulicz, 'Berlin. klin. Woch.,' April 22nd, 1895.

† D. Owen, 'British Medical Journal, 1896, vol. ii, p. 1017. Cunningham, 'New York Medical Record,' January 15th, 1895.

‡ Svehla, 'Wien. med. Blatt,' 46-52, 1896. Abstract in 'British Medical Journal,' 1897, vol. i, epitome No. 437.

removing it from animals, and noting the results. In rabbits no change occurs in the blood, blood-forming tissues, or in the weight of the animal. In dogs its removal is followed by anæmia, leucocytosis, weakness, increased appetite, and impaired growth, but the animals are able to live without it. Though the thymus resembles the spleen, it does not undergo any compensatory hypertrophy in splenectomised dogs,* as one might perhaps have expected. After removal of the thyroid the thymus is often found to be enlarged, but this does not prevent the characteristic symptoms developing.†

In frogs, however, complete removal of the thymus is described as bringing about death from toxæmia.

Persistence.—The thymus not uncommonly is found well formed and normal in anatomical and histological structure long after the time at which it should have completely atrophied. It may be found accidentally when death has occurred from some definite and sufficient cause, so that no question arises as to whether the thymus had anything to do with the fatal result. One of the best examples that I have met with was in a boy aged sixteen years, who died from fracture of the skull, the result of a bicycle accident. Claude‡ has

* Laudenbach, 'Archiv de Physiolog.,' 1897, p. 410.

† Cadeuc et Quenard, C.r.- Soc. Biolog., Paris, 1894, p. 308.

‡ Claude, Bull. Anat. Soc. Paris, 1897, p. 219.

recorded persistence of the thymus in a woman at the advanced age of ninety-four years.

In some cases the persistent thymus either preserves the size of a well-developed gland or is somewhat smaller; in the latter case its involution has been delayed, but is nevertheless commencing. In other cases the persistent thymus is much larger than it is at its normal maximum; there is then either hypertrophy or hyperplasia in addition to persistence.

Persistence and *hypertrophy* of the thymus are often difficult to separate from each other; the size of the thymus is subject to considerable variations, and the rate and degree of its involution, as already stated, is far from uniform in different individuals. The enlargement may be due to hypertrophy, *i. e.* to an orderly and regular increase of the constituents of the normal gland, or to hyperplasia, in which there is an overgrowth of the lymphoid tissue, so that the normal histological appearances are lost.

In order to distinguish with certainty between these two conditions—persistence and hypertrophy of the thymus, and persistence with hyperplasia—microscopic examination is necessary.

In hypertrophy the normal arrangement and lobulation are fairly well preserved; it is possible that a diminution in the number of Hassall's concentric corpuscles may occur, and be due to phagocytosis. They may also vary in size without any ascertained cause, and show degenerative

changes. Thus, in a man aged twenty-six, Jacobi found the persistent thymus containing calcified concentric corpuscles.

Persistence of the thymus in certain diseases.—

This persistence of the thymus may, if diseases such as exophthalmic goitre, Addison's disease, myxœdema, or acromegaly supervene, enable the gland to undergo an hypertrophy. Possibly it assists in the production of an antagonistic leucocytosis. It is difficult to go further, and to believe that the thymus has any special internal secretion, or' if it has, that it is in any way different from that which hypothetically might be provided by the lymphatic glands and lymphoid tissues of the body generally. This view is perhaps chiefly suggested by the clinical observation that thymus gland has seemed to do good in some cases of Graves' disease; it might be thought that an internal secretion of the thymus antagonises that of the thyroid, but in this connection it should be remembered that while the thymus gland is practically always enlarged in exophthalmic goitre the symptoms are not thereby relieved. So that at best it is only an attempt at compensation that has failed; on the other hand, Dr. Hector Mackenzie* has come to the conclusion from the examination of the published cases, and from personal observation, that thymus feeding does not really modify the course of Graves' disease.

* Mackenzie, 'American Journal of the Medical Sciences,' February, 1897.

Marie* has described the thymus as becoming revived or rejuvenated in certain conditions of the thyroid and other vascular glands; for example, in such different diseases as myxœdema and exophthalmic goitre. But it is difficult to explain this as other than an accidental persistence if we accept the view that these two diseases are due to the opposite conditions of athyroidism and hyperthyroidism—an absence on the one hand, and an excess of thyroid secretion on the other. In cretinism or congenital myxœdema the thymus is, according to Marie, almost constantly persistent.

In all these various conditions, however, the revival or persistence with hypertrophy are unable to cure or prevent the symptoms of the disease. It is noteworthy that a persistent and enlarged thymus has been found in cases of epilepsy, and in a peculiar diathetic condition called the status thymicus or lymphaticus, in which the other lymphoid tissues of the body show hyperplasia.

Histological condition of the thymus when persistent in various diseases.—In cases of exophthalmic goitre,† and in one case of acromegaly observed by myself, the concentric corpuscles of Hassall in the persistent thymus were found to be larger than natural. In the latter disease they might be said to share in the giant growth.

* P. Marie, Bull. et Mém. Soc. Méd. des Hôp. Paris, 1893, p. 136.

† Edmunds and Mackenzie, 'Path. Trans.,' vol. xlviii.

In a case of Graves' disease Soupault* described a further stage, viz. an adenomatous growth of the epithelial elements of the thymus gland. In a case of hæmophilia, and in one of purpura, Acland† noted the presence of what were probably epithelial proliferations of the concentric corpuscles of Hassall.

Enlarged thymus and sudden death.—A subject of considerable practical interest is the relation of an enlarged thymus gland to sudden death. In many cases of sudden death occurring in adults who have previously, as far as is ascertainable, been in fair health, there is very little found at the autopsy to account for death, which is often due to cardiac failure or syncope; this is a fact within the experience of every pathologist. In some similar cases occurring in earlier life a large thymus is the only gross change found, and is therefore thought to be the cause of death. It is possible, however, that the presence of a large thymus is sometimes a mere coincidence. On the other hand, there are various ways in which an enlarged thymus gland has been thought to precipitate death. Death has been referred to sudden engorgement of the thymus mechanically interfering with respiration by compressing the trachea against the spine. This mechanical effect is much more likely to be effective if the head and neck are

* Soupault, Bull. Anat. Soc., 1897, p. 592.

† Acland, 'Trans. Path. Soc.,' vol. xxxvi, p. 491.

extended on the trunk, as may occur when the head is allowed to fall backwards over a pillow. Under such circumstances the enlarged thymus is fixed by the manubrium sterni in front, and the lordosis of the spine compresses the trachea between the bodies of the vertebræ behind and the thymus gland in front. This compression is then likely to occur at the junction of the cervical and thoracic portions of the trachea. It is said that in rickety children with muscular debility the head may fall back, and that the feeble child may not be able to flex it; if there is a large thymus present the trachea may be so narrowed that death results.

This explanation for "thymic asthma" probably accounts for some cases, but thymic asthma and laryngismus stridulus have been somewhat mixed up. Some cases regarded as thymic asthma have been found to be associated with thymus glands of normal or small size, and are therefore probably examples of that rare event, death from laryngismus stridulus. Some authorities, in fact, consider that most, if not all, of the cases of so-called thymic asthma are cases of laryngismus stridulus in which as a coincidence the thymus has been enlarged. There is at any rate absolutely no evidence that laryngismus stridulus is solely due to an enlarged or hypertrophied thymus.

Probably many cases regarded as thymic asthma are really due to laryngismus stridulus, while there seems to be no doubt that the enlarged thymus

can, if the head be retracted, compress the trachea, so that the view that the enlarged thymus can mechanically obstruct respiration must not be given up.

It has also been suggested that the enlarged thymus may produce and throw out into the circulation a large amount of the substance which endows the watery extract of the gland with the power of lowering the blood-pressure, and that fatal syncope is thus produced. This would account for cases where death has occurred from cardiac failure and not from asphyxia; but it is difficult to see why the toxic effect, in a lesser degree, should not have been manifested more frequently in the same individual, and why it should only be exerted in a single attack so intense as to destroy life. Though an ingenious suggestion, and one in touch with the spirit of the present time, which explains everything by a toxin, it cannot be said that it is in any way proved.

A large thymus may press upon the heart and vessels, and so embarrass their action as to lead to cardiac failure. Another mechanical effect of an enlarged thymus that is quite conceivable is pressure on the vagi; some sudden movement might easily so stimulate the vagi as to stop the heart in diastole. This was perhaps the explanation of death in a boy aged six years, who died of cardiac failure lasting twenty minutes, and whose thymus was in a condition of marked hyperplasia, the thymus together with the trachea weighing no

less than eleven ounces. During life he was under the care of Dr. H. A. des Vœux, who recognised the existence of a tumour in the anterior mediastinum.

Another and important explanation of the association between the occurrence of sudden death and the presence of an enlarged thymus gland is that the enlargement of the gland is part of the general condition called lymphatismus, status lymphaticus, or status thymicus. The subjects of this diathesis have a pale transparent skin, and are well covered with fat ; the tonsils, lymphoid tissue at the base of the tongue, the lymphatic glands, thymus, and spleen are large ; there are other congenital changes—for example, in the eyes, and hypoplasia, or insufficient development of the aorta.

These children, like rickety infants, are liable to laryngismus stridulus and tetany, and, according to Escherich,* are in a condition of latent irritability of the nervous system, and are therefore especially likely to be the subjects of convulsions, and to die from cardiac failure without any very sufficient cause. Thus deaths during or after emotional disturbance, anæsthetics, small operations, and other trivial causes may be explained. Osler† speaks of one such case proving fatal during the administration of anæsthetics for adenoid vegetations ; this raises the important question, To

* Escherich, 'Berlin. klin. Woch.,' 1896.

† Osler, 'Practice of Medicine,' ed. 3, p. 827.

what extent are adenoids a manifestation of lymphatism, a condition in which death may unexpectedly supervene and upset our calculations? The tragic death of Professor R. Langerhans' son in 1896, immediately after his father had given him a hypodermic injection of Behring's antidiphtheritic serum in order to protect him against infection from a case that had arisen in the house, is explained by Escherich as being due to lymphatism. More than forty cases of sudden death occurring in lymphatism have been recorded.

To sum up—(1) An enlarged thymus gland may be found as a coincidence in cases of sudden death; for example, in laryngismus.

(2) It may mechanically cause compression of the trachea, especially when the head and neck are extended, and so give rise to asphyxia.

(3) It may mechanically compress the heart, or possibly the vagi, and so lead to cardiac failure.

(4) An enlarged thymus may be part of the status lymphaticus, which is a condition where death may follow apparently inadequate causes.

Hyperplasia of the thymus gland.—Hyperplasia of the thymus gland may give rise to a tumour of considerable size; thus, in a case already referred to, the thymus and trachea of a boy weighed eleven ounces. Hyperplasia must be distinguished from primary sarcoma of the thymus by its microscopic appearances, the absence of any infiltration of adjacent parts, and the absence of any secondary growths.

It is not improbable that some cases recorded as lympho-sarcoma or sarcoma in the anterior mediastinum, without any evidence of metastases or infiltration of neighbouring parts, are in reality examples of hyperplasia of the thymus, especially when the tumour is described as retaining the normal outlines of the organ.

Microscopically the normal arrangement of the thymus is lost and the whole field obscured by small round cells, resembling the lymphocytes of a normal thymus. Hassall's corpuscles do not share in the hyperplasia, and are only seen in the remains of the normal thymus.

Acute inflammation starting in the thymus gland must be extremely rare. The gland must, however, necessarily suffer by extension in cases of pericarditis, pleurisy, and Ludwig's angina. Suppuration in the thymus has been seen in association with double pleurisy, but it is a curiosity. The neighbouring lymphatic glands may be attacked with acute or chronic adenitis in a variety of conditions, but this is to be distinguished from inflammation of the thymus itself. It is an interesting question whether the rare disease, indurative mediastino-pericarditis, may not sometimes start in the thymus gland; I have seen one case in which the fibrosis was so excessive in the position of the thymus that clinically the case was thought to be a mediastinal growth.

Durante* has recorded extreme fibrosis of the

* Durante, Soc. de Biolog., Paris, March 14th, 1896.

thymus in a child aged twenty-seven days; its weight was only 1·5 grammes.

Hæmorrhages may occur into the thymus in common with other parts of the body in toxæmic conditions, in asphyxia, backward pressure in mitral disease, and sometimes in the newly-born as the result of difficult birth. The extravasations are commoner under the capsule than into the substance of the thymus. Durante has described two cases—one still-born, the other three days old—in which the thymus was the only organ into which hæmorrhage had occurred.

Tubercle very rarely affects the thymus; in generalised tuberculosis it may be affected like the rest of the body. One case of primary tubercle of the gland is on record.

In diphtheria commencing necrotic changes were observed by Jacobi* in two out of nine cases examined.

Syphilis.—In congenital syphilis small abscesses were formerly described, but it has since been thought that these were either due to post-mortem softening, or to physiological accumulations of lymphocytes. Jacobi refers to four cases, and lays stress on the marked fibrosis, one of his cases contained a small gumma. Gummata of any size have not been met with in the thymus, but it should be remembered that a periosteal node may

* Jacobi, 'Trans. Assoc. American Physicians,' vol. iii, p. 299.

develop on the posterior surface of the sternum, and so project into the anterior mediastinum that pressure symptoms suggesting mediastinal tumour may result.

Leukæmia.—Thymus may be enlarged in cases of lymphatic leukæmia so as to give rise during life to post-sternal dulness. In a case observed by Muir (Allbutt's 'System of Medicine,' vol. v, p. 643), in a woman aged twenty-five, the spleen and the thymus were both much enlarged, while the lymphatic glands were hardly affected.

Lymphadenomatous growths may occur in the position of the thymus; in the cases I have seen it appeared that it was probably due rather to the lymphatic glands of the anterior mediastinum being involved than to lymphadenoma of the thymus itself. But lymphadenoma is said by Letulle* to be the commonest new growth arising primarily in the thymus, and other authors record cases. Possibly the term has been used to designate cases of hyperplasia. If the growth in the thymus is associated with lymphadenoma elsewhere, the condition is rightly called lymphadenoma, but nothing is gained by speaking of enlargement and hyperplasia affecting the thymus alone as local lymphadenoma.

Primary tumours arising in the thymus gland.—The thymus though not a foetal relic, inasmuch as

* Letulle, 'Archiv. général de Médecine,' vol. clxvi, p. 641, 1890.

it reaches its acme of development after birth, is yet on very much the same footing as those structures that atrophy after birth. Morbid lesions may occur in these foetal relics, and probably from the interest attaching to Cohnheim's theory of tumour formation from foetal inclusion, much attention has been paid to tumours arising in foetal structures and relics. To some extent this has been overdone, for the ductus arteriosus and ductus venosus are practically never the site of growths, while the vermiform appendix is very rarely the site of a primary new growth. The thymus gland, however, certainly supports the contention by being comparatively often the starting-point of a new growth. The fact that, according to Wilson Fox, mediastinal new growths are met with in the anterior mediastinum nearly twice as frequently as in the posterior mediastinum, may in part be due to growths originating in the thymus.

Before describing the forms of tumours arising primarily in the thymus it will simplify matters to glance at the development of the organ. In the first instance, the thymus and tonsil are both epithelial outgrowths from the alimentary canal, which become surrounded by leucocytes; this secondary lymphoid infiltration becomes the important part, while the epithelial elements undergo atrophy. The thymus is at first a paired epithelial tube derived from the third, fourth, and partly from the second branchial clefts; it then undergoes ramification, and gives rise to condensation of the connec-

tive tissues around,* which then become infiltrated with leucocytes as soon as they are found in the body ; thus the more permanent part of the thymus is formed. The epithelial elements become changed into the concentric bodies known as Hassall's corpuscles.

It has been suggested that the thymus is a protective organ, providing phagocytes for the branchial arches in fishes, in which it is a permanent and well-developed organ. This view is of interest in connection with the early atrophy of the organ in man, an event which is otherwise rather difficult to explain. But if it be specially related to the very transitory existence of branchial clefts its disappearance in man is intelligible.

Innocent tumours, apart from hyperplasia of the gland already referred to, practically never occur in the thymus. It is quite conceivable that the epithelial cells, which normally degenerate into Hassall's concentric corpuscles, might proliferate and form an adenoma, but a simple adenoma has hardly ever been met with. Soupault† has described a unique case in a girl aged eighteen years, who died with exophthalmic goitre ; the thymus contained cysts lined with columnar epithelium. This he regarded as a developmental error. I have described a case in which a compound tumour of the thymus contained adenomatous growth resem-

* Gulland, 'Laboratory Reports,' Royal College of Physicians, Edinburgh, vol. iii, p. 172.

† Soupault, 'Bull. Soc. Anat.,' Paris, July, 1897.

bling Lieberkühn's crypts, but sarcomatous tissue and cartilage were also present. Dermoid cysts occasionally occur in the anterior mediastinum. Hare, in his monograph on mediastinal disease (1889), refers to seven cases; but they are not derived from the thymus gland, though they may displace it, and so occupy its anatomical position. Cysts derived from branchial clefts are not the dermoid cysts, inasmuch as they do not contain hair. Histologically these cysts, for which Shattock* proposes the title mucosal to distinguish them from true dermoid cysts, do not contain the stratum granulosum. Now a cyst lined by epithelium in the thymus would be derived from the thymus diverticulum, and as this comes off from the fore-gut, such a cyst, if it occurred, would come under the heading of a mucosal cyst, and would be homologous to a cyst formed from a branchial cleft. Hence a true dermoid cyst cannot develop from the elements of the thymus.

Practically the tumours of the thymus gland are structurally malignant, and may be considered under the usual heads of sarcoma and carcinoma. Before proceeding to describe them, however, it is interesting to note (1) that the sarcomatous tumours may be complex, and contain other forms of connective tissue, such as fat, fibrous tissue, smooth muscle, and exceptionally cartilage; (2) that epithelial proliferation may co-exist with sarcoma-

* Shattock, 'Trans. Path. Soc.,' vol. xlviii, p. 254.

tous growth, and (3) that in some instances something like a combination of sarcoma and carcinoma may be present in the same growth. In their complexity some thymus tumours resemble parotid growths, and it is interesting that they are in some way analogous in their embryonic origins, branchial clefts for parotid tumours, and the thymus diverticulum from the pharynx. In the irregular and somewhat atypical character sometimes displayed by the growths of the thymus a resemblance to neoplasms in the supra-renal and pituitary bodies, also ductless glands, may be traced.

Sarcoma starts in the fibrous framework or in the lymphoid tissue of the organ, while carcinoma arises from the remains of the thymus diverticulum from the fore-gut.

Sarcomata are commoner as primary tumours of the thymus than carcinomatous growths. Very various forms are met with. Small round-celled growths, the cells of which resemble the small lymphocytes normally found in the thymus, may occur. These, as shown by infiltration of adjacent parts and by secondary growths, are undoubtedly malignant. I have seen these growths to be so freely traversed by blood channels, not blood-vessels, since the boundaries of the vascular spaces were composed of the naked cells of the growth, that an alveolar arrangement resulted. The blood may break into the growth and form hæmorrhagic areas. It is this kind of tumour that may in very rare cases pulsate, and so

make the diagnosis from aneurysm more difficult than it is already.

The round-celled growth may contain a varying amount of interstitial fibrous tissue. When the cells are small, and the fibrous tissue so delicate that it resembles the reticulum of a lymphatic tissue, the growth is called a lympho-sarcoma. It is to tumours of this histological structure that the term lympho-sarcoma is strictly applicable, and not to growths thought to arise in lymphatic glands, which should be called lymphatic gland sarcoma.

The amount of fibrous tissue, on the other hand, in some cases of round-celled sarcoma arising in the thymus gland may be large, and the tumour then merits the title of fibro-sarcoma, or rather fibrifying sarcoma. The round cells may be of a medium or comparatively large size.

Spindle-celled sarcoma may also occur, and may present a considerable amount of fibrous tissue, again justifying the term fibrifying sarcoma. A growth composed of variously and irregularly shaped cells, combined with considerable hæmorrhagic extravasation, may be met with, and perhaps is best described as an irregular-celled sarcoma; but the size and irregular shape of some of these cells recalls Dansac's * description of "voluminous cells" in thymus tumours, which he regards as derived from the epithelial elements of the thymus diverticulum.

* Dansac, 'Bull. Soc. Anat. Paris,' 1893, p. 199.

Carcinoma arising in the thymus is characterised by its atypical structure, and in addition by the various forms that may be met with.

The cells composing the growth are generally somewhat large, and may resemble those seen in the Malpighian layer or stratum mucosum of the skin. Letulle mentions mucoid degeneration occurring in the cells, and in one specimen I examined the cells showed very marked vacuolation, and presented an appearance exactly like that which at the time (1893) was regarded by some writers as being evidence of the much-discussed intra-cellular parasites of cancer. In other cases of carcinoma epithelial pearls may be present, thus plainly indicating that the growth, like the normal concentric bodies of Hassall, is derived from the primitive thymus diverticulum from the fore-gut. The combination of polyhedral cells and squamous cells in the same tumour has also been observed. Sometimes the cells are large, and resemble the cells seen in adenomata of the suprarenal body or liver ; these cells are not improbably a transition from a squamous to a spheroidal-celled type, and may correspond with the "voluminous*" cells regarded by Dansac as derived from the epithelial elements in the normal thymus. Carcinoma of a squamous-celled type, and also of a transitional type between squamous and spheroidal-celled carcinoma, thus occurs ; and, in addition, a form in which the cells are spheroidal and small, somewhat resembling those seen in

sarcoma, has been described.* About the carcinomatous nature of the latter some doubt appears to me to be permissible. Thymus tumours may vary greatly in different areas, so that what appears to be carcinoma in one region is associated with sarcomatous tissue in another part of the same growth. It is possibly to tumours of this character that the rather vague and non-committal term of "endothelioma" has been given. Growths of this kind suggest the possibility of combined sarcomatous and carcinomatous growths occurring in the thymus, just as they occasionally do in the kidney and elsewhere.

Secondary tumours are sometimes seen in the position of the thymus gland.

The *clinical aspects* of tumours arising in the thymus gland are those of growths in the anterior mediastinum; the growth tends to spread downwards over the anterior surface of the pericardium and upwards around the great vessels. It may invade the pericardium and give rise to pericarditis, with effusion sometimes of a hæmorrhagic character. Its most important manifestations are those due to pressure on the superior vena cava and innominate veins; the thin-walled veins are readily compressed and may be invaded by growth, which may thus extend towards and even pass into the right auricle of the heart. The veins of the head and neck become dilated, and cyanosis

* Paviot et Gerest, 'Archiv. de Méd. Expériment.,' September, 1896.

and œdema of the upper part of the body comes on. In some cases the development of a collateral circulation to some extent compensates for the obstruction. It is noteworthy that the aorta is seldom infiltrated or compressed by the growth, though the thinner walled pulmonary artery may be somewhat narrowed. Pleural effusion may occur; this, together with signs of venous obstruction, absence of accentuation of the second sound over the aorta, and of pulsation, are points in favour of a growth as against an aortic aneurysm in the anterior mediastinum.

